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# Research of the CO<sub>2</sub> Laser MOPA System

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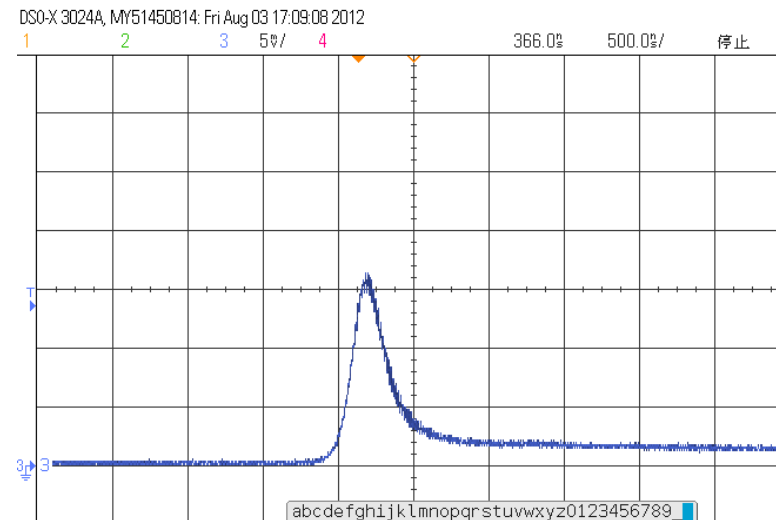
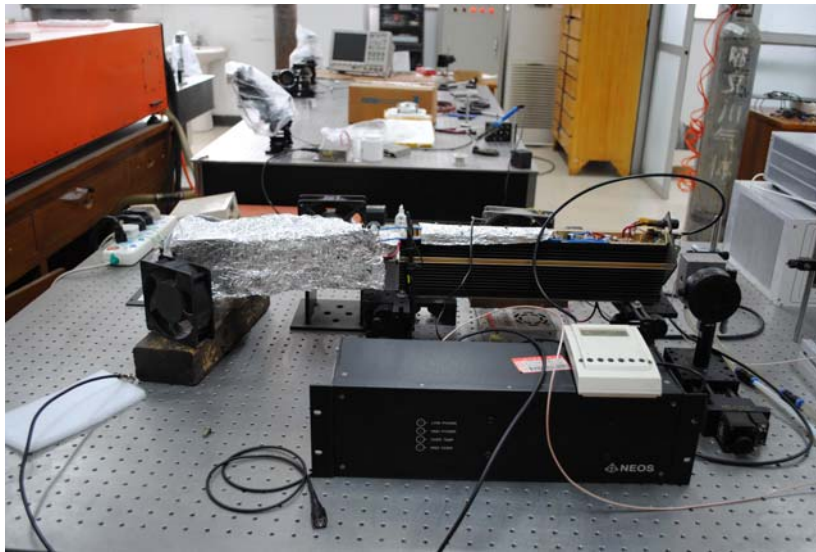
# Introduction

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**Experimental research of a pulse CO<sub>2</sub> laser MOPA system is presented in this report. The laser amplifier is consisted of two CP4000 fast axial flow CO<sub>2</sub> lasers which can produce 4 kW CW laser output each. A mechanical Q-switched CO<sub>2</sub> laser oscillator with a pulse repetition rate of 1-12 kHz and an AO Q-switched low pressure DC discharged wavelength tunable CO<sub>2</sub> laser oscillator with a pulse repetition of 10-70 kHz were developed, the pulse duration for both oacillator is about 200 ns. The maximum average power of 1 kW (with nearly TEM00 beam quality) can be obtain in our CO<sub>2</sub> laser MOPA system, while the pulse duration does not change after the amplfier, and the self-oscillation of the MOPA system is not observed. In the future the laser pulse duration will be shortened by the combination of cavity dumping and electro-optical Q-switching.**

# AO Q-switched Tunable CO<sub>2</sub> Laser oscillator

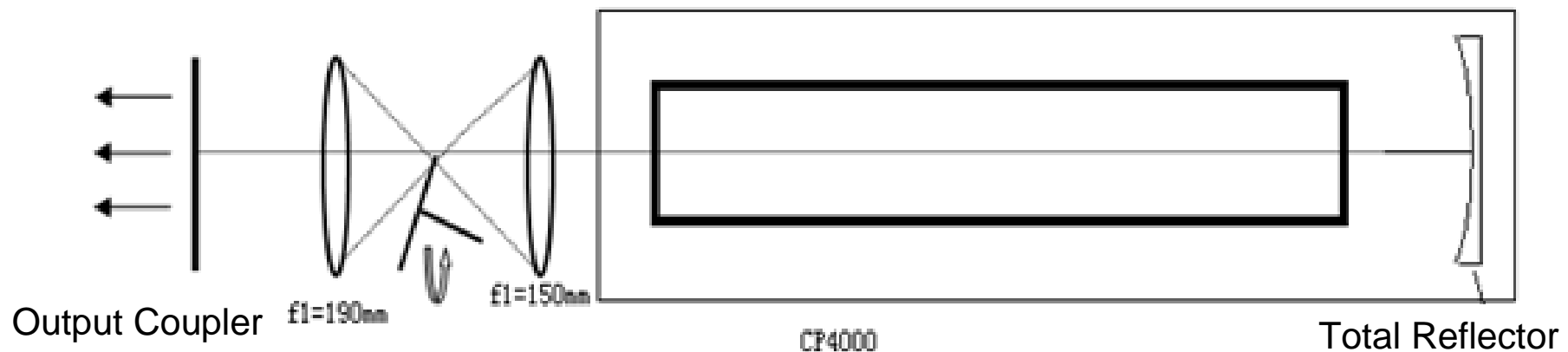
- A Synrad J48 series RF laser was modified to a tunable CO<sub>2</sub> laser, and an Neos AO modulator was used as a Q-switch.



- About 250 ns pulse width, up to 30 kHz, average output power 8 W.
- Lower average output power, for high insertion loss of the AO modulator.

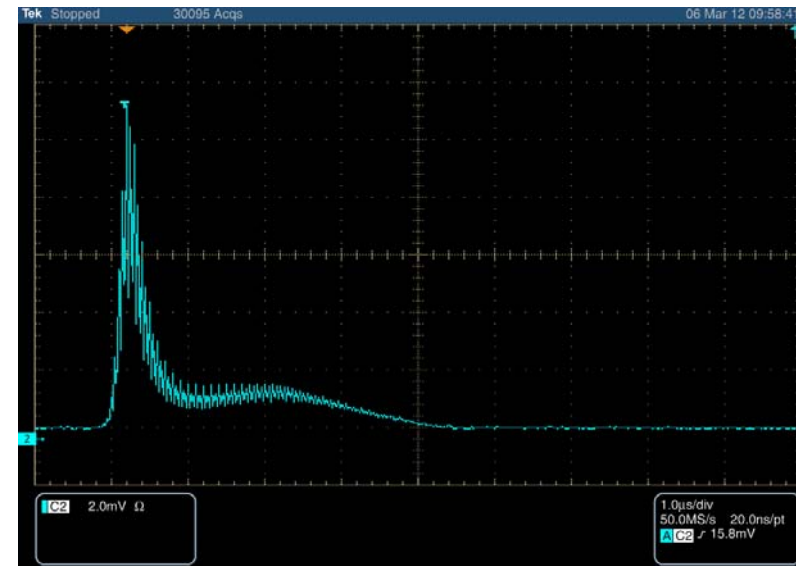
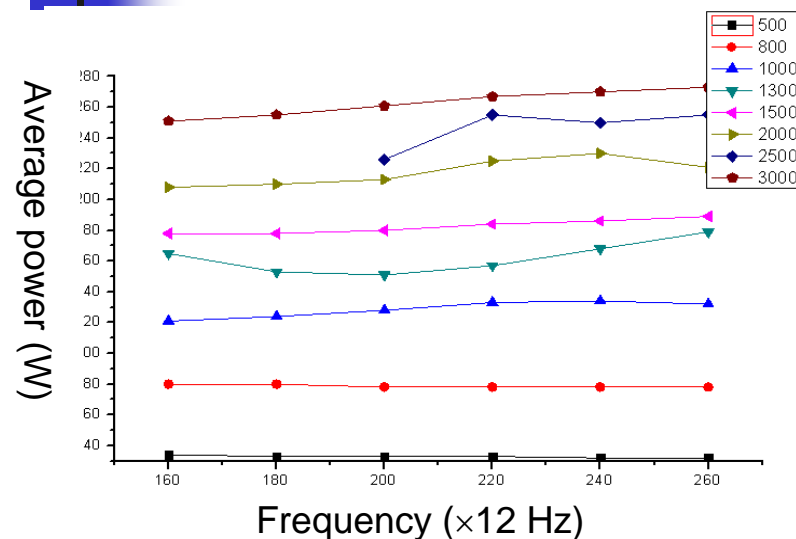
# Mechanical Q-Switched CO<sub>2</sub> Laser oscillator-Design

- A CP4000 DC discharged fast axial flow CW CO<sub>2</sub> laser was modified to a mechanical Q-switched CO<sub>2</sub> laser



- A rotating chopper Q- switching method with an intracavity telescope is adopted. The rotating chopper blade is located at the confocal position of the telescope.
- The 180 mm diameter chopper blade has twelve 0.8 mm wide slits around. A rapidly rotating rotor with highest rotation speed 24,000 rpm is used.

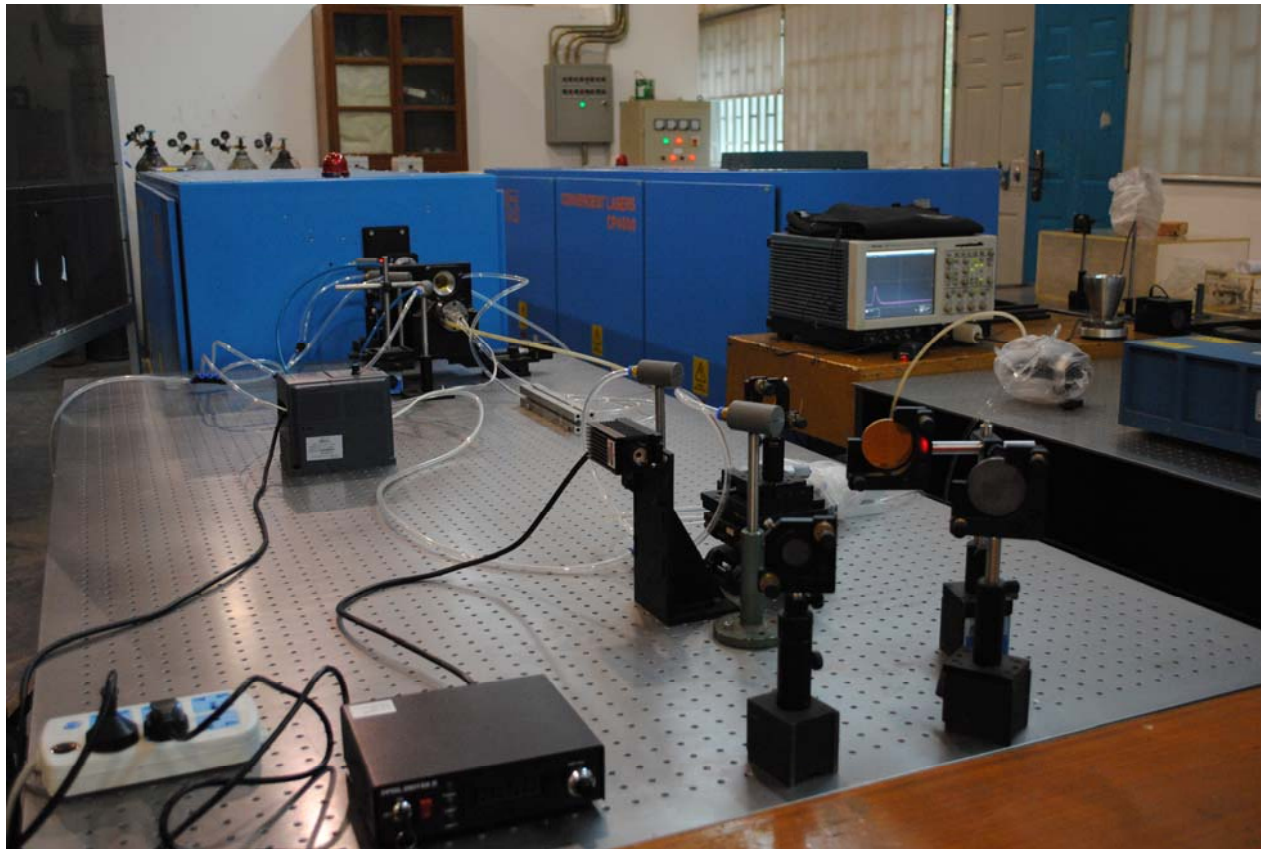
# Mechanical Q-Switched CO<sub>2</sub> Laser oscillator-Output



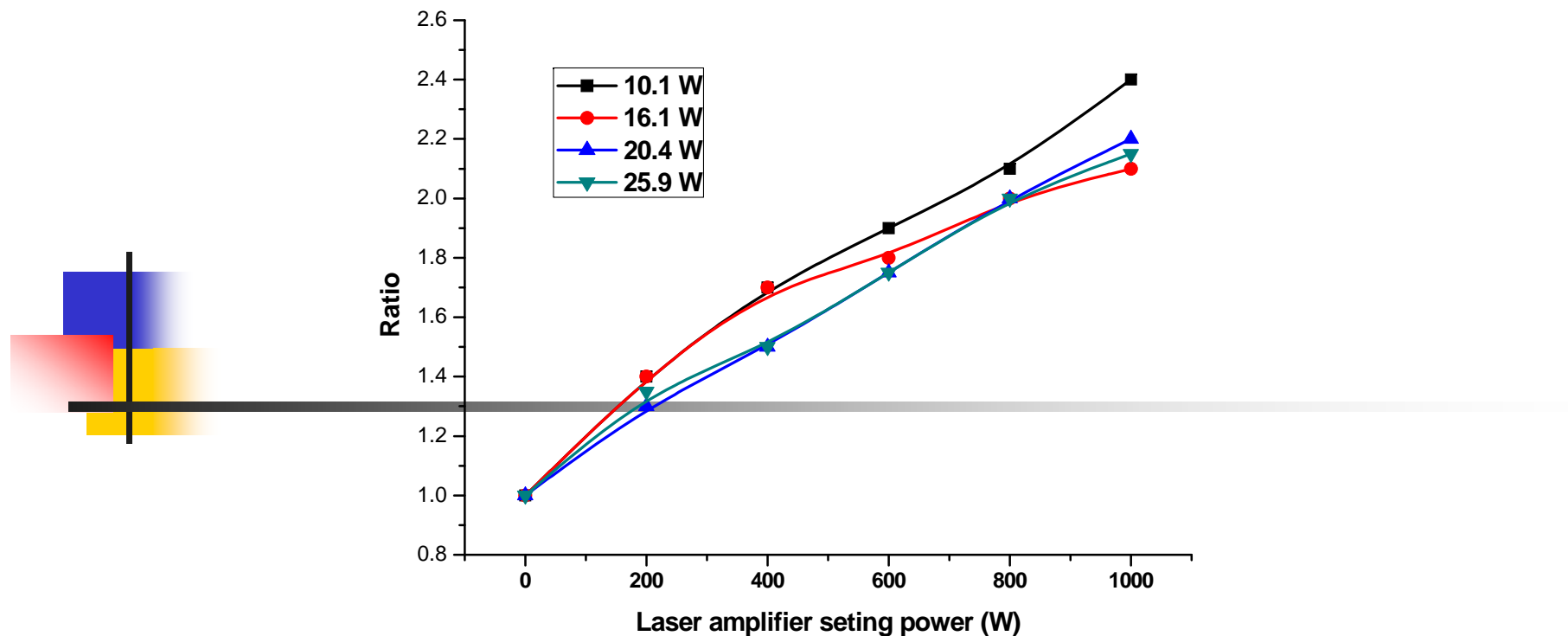
- Laser produced plasma in the focal point of the intracavity telescope has influences on the laser output power and pulse shape.
- About 300 W average power can be obtained.
- Laser pulse width is about 300 ns with a tail of several μs.

# CO<sub>2</sub> laser Amplifier

**A fast axial flow CO<sub>2</sub> lasers CP4000 (nominal CW output power 4 kW) is used as amplifier, in which the total length of discharge tubes is about 6 m, and the diameter of the discharge tube is 19 mm.**



# Research of the CO<sub>2</sub> Laser Amplifier

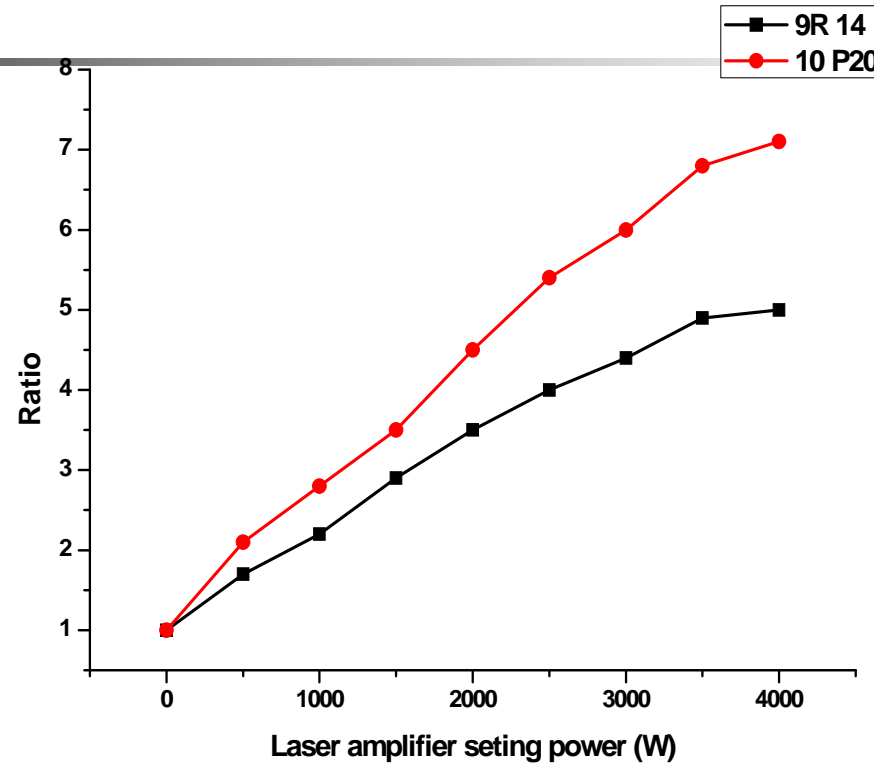


Amplifying ratio vs setting power of the amplifier for different input laser power

- Amplifying ratio of the laser amplifier linearly increased with the setting power value.
- No saturation was found, for the input was low.

# Research of the CO<sub>2</sub> Laser Amplifier

## Multiline Amplifier



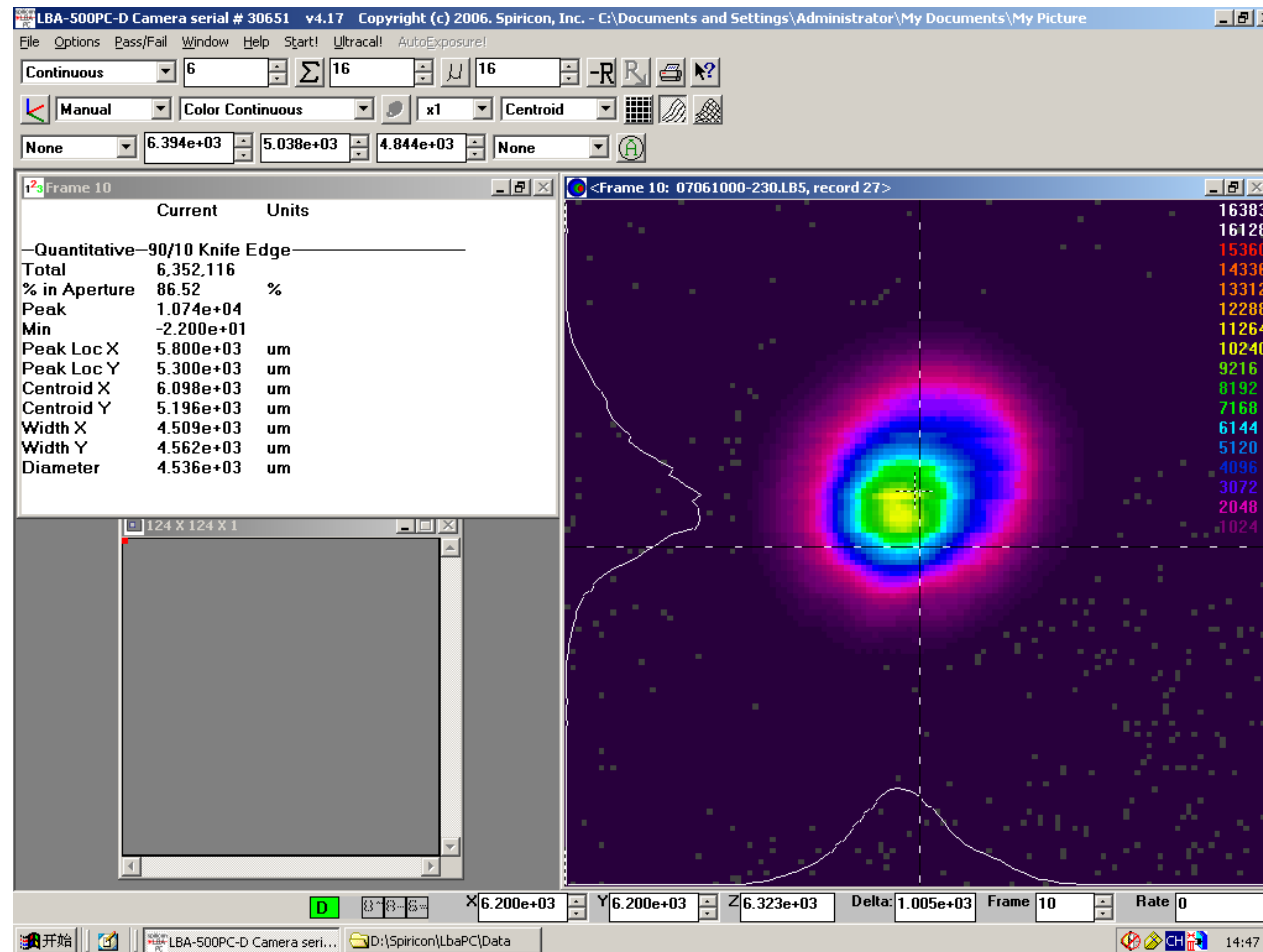
- Amplifying ratio vs setting power of the amplifier for different laser line

**10P20: input power 20 W**

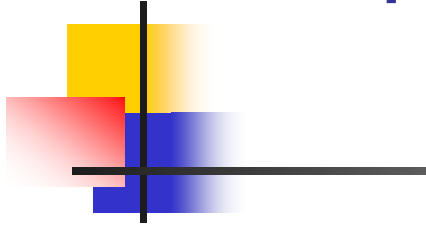
**9R14: input power 11 W**



# Research of the MOPA CO<sub>2</sub> laser beam profile

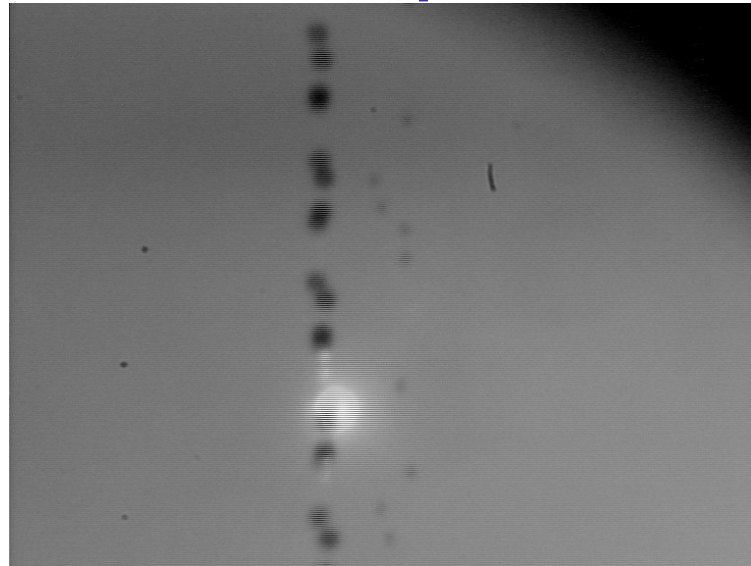


# Laser produced plasma in the air



5 cm focal length

# Laser bombed liquid Sn droplets



15 cm focal length



# Future works on MOPA CO<sub>2</sub> Laser System

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- CdTe EO Q switched CO<sub>2</sub> laser Oscillator, Cavity dumping to obtain <30 ns pulse width.
- Increasing the input power by multiline configuration.
- Reducing the losses in the beam matching optics.